



# Carbon Monitoring System(CMS): Local Biomass

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The GSFC portion of the CMS-Biomass project focuses on quantifying terrestrial vegetation carbon stocks for a set of “local” areas using small-footprint lidar, and then using these data to validate a national biomass map

The GSFC team has now completed above-ground biomass (AGBM) mapping and error analysis for the four sites. Aggregated results are comparable to inventory-based USFS estimates, and show improvements in urban areas.

Year 2 activities will focus on (i) evaluation of the national biomass map from CMS; (ii) using re-measured lidar and lidar combined with Landsat disturbance information to measure biomass change

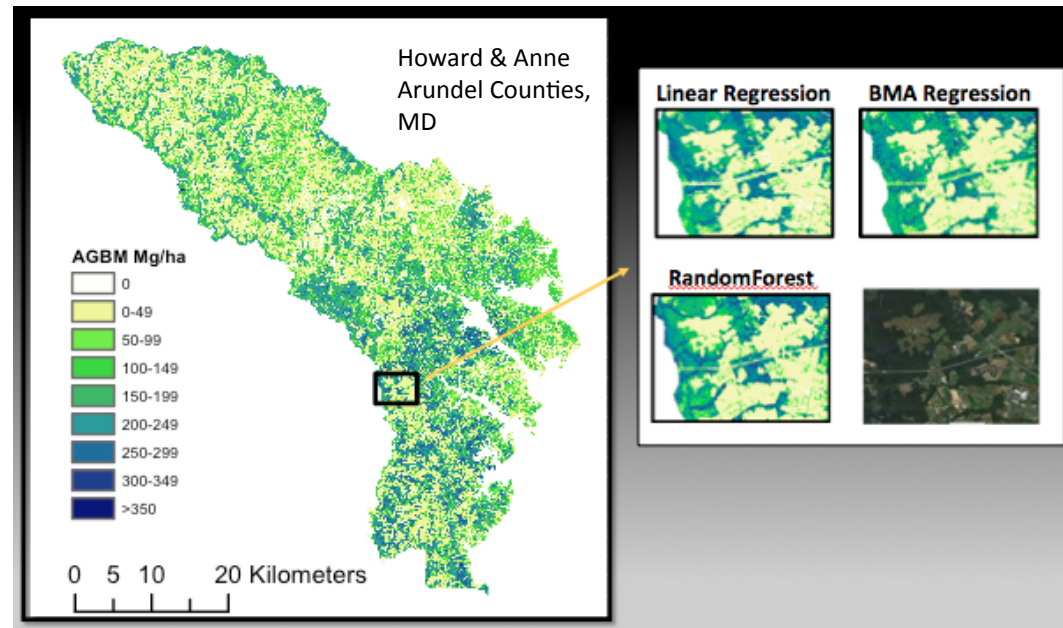


Figure 1: Above-ground biomass of Howard and Anne Arundel Counties in Maryland

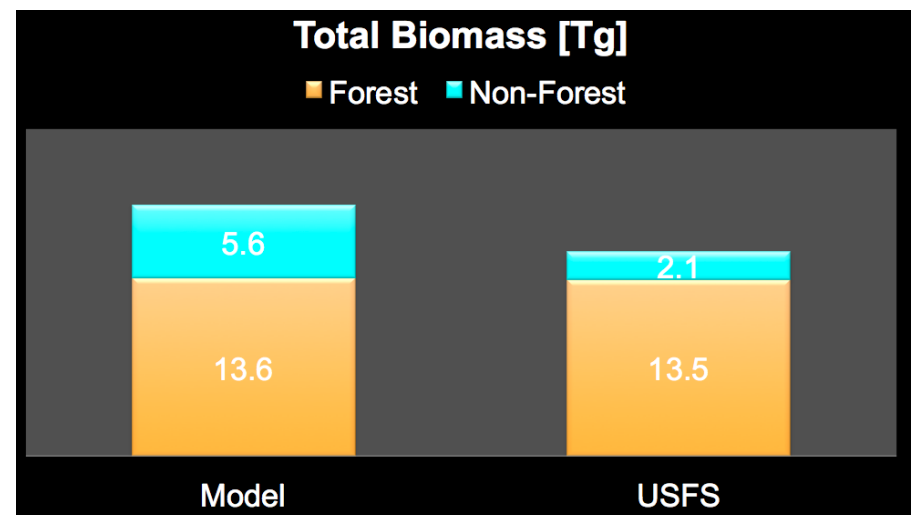


Figure 2: Comparison of one CMS estimate (BMA) of biomass with USFS-FIA plot estimates



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## References:

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**Data Sources:** This is a joint effort composed of the US Forest Service and several NASA centers, including NASA Ames, JPL and NASA GSFC. We will estimate aboveground biomass by combining data from several different satellites with Forest Inventory and Analysis (FIA) and other high-quality forest carbon/biomass inventory data. We will produce continental U.S. map of above-ground biomass, fully mapping errors and uncertainties. We will demonstrate how well biomass can be quantified with high-quality remotely sensed data taken at fine spatial resolution for selected sites representative of U.S. forest types and conditions.

## Technical Description of Image:

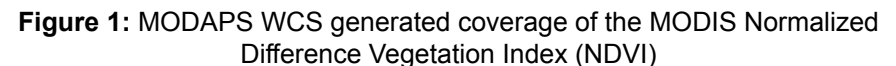
**Figure 1:** Above ground biomass for two Maryland counties. Map shown on left was generated using the BMA approach. Insets show detail of maps generated using different methods and visible imagery of the inset (bottom right).

**Figure 2:** Comparison of one CMS estimate (BMA) of biomass with USFS-FIA plot estimates. Model and USFS results are essentially identical of forested areas (that is areas classified as forest by NLCD), but diverge strongly for non-forest areas. This is a reflection of the fragmented and suburban nature of the counties and shows that non-forest areas are a significant pool of carbon that must be accounted for properly.

**Relevance for future science and relationship to Decadal Survey:** NASA has expanded the scope of the terrestrial biomass product to include more analysis at local and regional scales (i.e., project, county, and state level) and a new model-data fusion study to assess changes in carbon stocks over multi-year time scales. NASA Goddard Space Flight Center will lead these efforts, leveraging its considerable expertise in the preparation and analysis of airborne lidar data, advanced time series Landsat data analysis, geospatial data manipulation, and carbon modeling/data fusion. The domain of the local scale, high-resolution analyses to be conducted using advanced airborne lidar and multi-temporal Landsat data in combination with forest inventory data will be significantly expanded. NASA will demonstrate how well biomass can be quantified with high-quality remotely sensed data taken at fine spatial resolution for selected sites representative of U.S. forest types and conditions.



- MODAPS WCS released January 19, 2012, implements Open Geospatial Consortium's (OGC) v1.0 Interface Standard.
- The WCS enables query and retrieval of MODIS Level 1B and Atmospheric data product across the Web, using platform-independent interfaces. The user interacts with the WCS in a synchronous session, with results returned within a brief time period.
- WCS returns data as a Coverage, a geographic data file, which may be modified and analyzed.
- MODIS WCS may be accessed at:  
<http://modwebsrv.modaps.eosdis.nasa.gov/wcs>



**Figure 2: System workflow of a WCS Request and Response**





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### **Software Development Team:**

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### **Technical Description of Images:**

**(Figure 1)** Web Coverage Service (WCS) provided a Moderate Resolution Imaging Spectroradiometer (MODIS) Coverage (image file), matching the following request parameters: MODIS\_NDVI (source science data set), Lat/Lon geographic region encompassing Chesapeake watershed, 2008-10-23 (temporal subset), 5° x 5° resolution, GeoTiff (output format), Sinusoidal (projection). The resulting file is converted to a three band (Red, Green, Blue) image using a color lookup table.

**(Figure 2)** MODIS Adaptive Processing System (MODAPS) WCS is constructed atop a foundation of existing Web Services, data processing systems and the MODIS science data archive. The end-user software client (either a Web application or command script), submits a request in one of the three standard methods specified by the WCS standard (GetCapabilities, DescribeCoverage, GetCoverage). The WCS interrogates the MODAPS Level 1 and Atmosphere Archive and Distribution System (LAADS) distribution database through routine LAADS Web Service calls, and submits a command file to the Sun Grid Engine (SGE), which interprets the command, extracts the data from MODAPS, generates the data file and streams the file along with job details back to the end-user client. These new WCS capabilities enhance the existing asynchronous MODIS Web Services that enable post-processing options (i.e. reformatting, reprojection) to be automatically performed on large amounts of MODIS data.

**Scientific significance:** This tool provides standard, automated access to scientific data, thus making it easier and faster to access the data needed to conduct research.

**Relevance for future science and relationship to Decadal Survey:** Since MODAPS WCS is based on an Open Geospatial Consortium (OGC), industry standard, it should be compatible with multiple clients commonly used by scientist to interrogate, retrieve and analyze geographic science data. This compatibility reduces the need to become familiar with a new application and to develop new, custom client interfaces.